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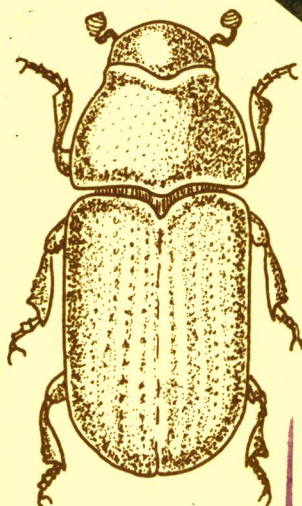
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BIOLOGICAL EVALUATION
AND DAMAGE SURVEY
Mountain Pine Beetle
in Ponderosa Pine

Kaibab Plateau
Kaibab National
Forest
Arizona

1975



Southwestern Region 3

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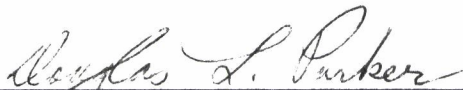
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Forest Insect and Disease Management
State and Private Forestry
Southwestern Region, Forest Service, USDA
517 Gold Avenue, SW
Albuquerque, New Mexico 87102

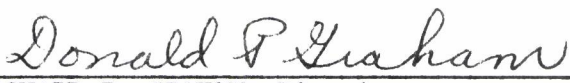
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Prepared by:


DOUGLAS L. PARKER, Assistant Director
Forest Insect and Disease Management


ROBERT E. ACCIAVATTI, Entomologist
Forest Insect and Disease Management

APPROVED BY:


DONALD P. GRAHAM, Director
Forest Insect and Disease Management


THOMAS G. SCHMECKPEPER
Deputy Regional Forester
State and Private Forestry

INTRODUCTION

A mountain pine beetle infestation in ponderosa pine on the Kaibab Plateau, Kaibab National Forest, was detected during an aerial reconnaissance survey in August 1973. Evaluation data collected later in 1973 indicated that the outbreak would increase. Since losses were mainly concentrated within the East Lake timber sale area, sanitation-salvage logging was recommended. Beetle-infested trees were marked and removal was planned prior to the beetle flight in July of 1974. However, infested trees were not removed and beetles flew and attacked green trees.

A biological evaluation and damage survey were conducted in the sale area in August and September 1974 to appraise current losses and predict the future trend of the outbreak. This report summarizes the survey data and provides a prediction of the future trend of the outbreak. Recommendations for coping with the infestation are also provided.

TECHNICAL INFORMATION

Insect.--Mountain pine beetle, Dendroctonus ponderosae Hopk.

Host.--Ponderosa pine, Pinus ponderosa Laws.

Location and Extent of Damage.--The infestation is located about 10 miles south of Jacob Lake, Arizona (Fig. 1, Appendix).

History of Outbreak.--The mountain pine beetle has caused heavy ponderosa pine losses on the Kaibab Plateau in the past. Blackman (1931) studied this beetle on the Plateau and identified the following outbreaks: 1837-1846, 1853-1864, 1878-1882, 1886-1892, 1906-1910, and 1916-1926. The two most severe and widespread epidemics were the 1916-1926 outbreak and the one centering in 1888. Localized tree killing was recorded from 1935-1938 and again in 1950.

Control programs were undertaken from 1919-1925 to suppress the outbreak. A summary of the number of infested trees treated by the peel and burn method and the acreages covered by treatment follows:

<u>Year</u>	<u>Trees</u>	<u>Acres</u>
1919-1922	362,000	17,000
1923	82,000	3,640
1924	27,780	29,400
1925	5,464	18,300

No records were found to indicate that control programs were undertaken during the other past outbreaks.

Life History.--The mountain pine beetle has one generation per year. Adults attack living trees in late July and early August. They bore through the bark to the cambium area and construct perpendicular egg galleries. Eggs are laid along the sides of galleries. After hatching, the larvae feed horizontally around the circumference of the tree. The beetle generally overwinters in the larval stage. In the spring, the larvae resume feeding. The mature larvae change into pupae and then into adults. The adults emerge in late July and early August and the cycle begins again.

Under favorable conditions, beetles can double or triple their numbers annually during the early years of an epidemic. After several years, beetle populations decrease to endemic levels.

METHODS

Mortality Plots.--Trees infested and killed by the mountain pine beetle were sampled on 488 quarter-acre strip plots (0.5 by 5 chains). Strip plots were systematically located along 18 lines spaced 20 chains apart. The total area surveyed was 4,040 acres. Trees were classified as follows: new, 1974 attacks; old, 1973 attacks; snag, 1972 or before attacks. In total, 122 acres were sampled, which is 3 percent of the survey area.

Green Stand Plots.--Stand structure data were collected on 506 variable plots (20 BAF) systematically located at 5-chain intervals along the strip plot lines. A Spiegel-Relaskop was used to record "count" trees. All trees greater than 4.5 inches d.b.h. were measured to the nearest inch.

Basal Area Calculations.--Basal area per acre estimates were computed for live and dead trees to provide an indication of the percent volume of timber affected by the mountain pine beetle.

RESULTS AND DISCUSSION

Prior to the mountain pine beetle outbreak, there were about 251 trees per acre (4.5 inches in diameter and above) in the survey tract. Tree composition and density in trees per acre were as follows: blackjack, 56.3; yellow pine, 1.6; white fir, 54.8; Douglas-fir, 17.6; blue spruce, 13.6; Engelmann spruce, 1.7; and aspen, 95.8 (Table 1, Appendix).

In the survey area, almost pure stands of pine occur mainly on ridgetops. Elsewhere, individual large pines and clumps of small diameter pines are interspersed with stands of white fir, Douglas-fir, and aspen. Spruces occur mainly in canyon bottoms or on moist sites.

The mountain pine beetle cumulatively has killed 9.6 trees per acre during the current outbreak (Table 2, Appendix). Four percent of the total stand and 23 percent of the pine type, 4 inches in diameter and above, have been affected to date. A mean of 4.5 trees per acre were attacked in 1974, 2.0 in 1973, and 3.2 in 1972 and before. The number of trees killed in 1974 was an increase of 2.3 times over the 1973 level. Refer to Figure 2 in the Appendix for photographs showing the groups of 1974 "faders."

Including all dead and currently infested ponderosa pine trees, 11 percent of the basal area per acre for all tree species and 36 percent of the ponderosa pine have been killed by the beetle. Since basal area estimates provide a relative measure for timber volumes, equal percentages of volumes were assumed to have been affected.

CONCLUSIONS

All information collected in the outbreak area in August and September 1974 indicates that the insect infestation will increase in 1975 over 1974. Insect broods were abundant and appeared healthy. Also, ponderosa pines on the Kaibab Plateau are obviously susceptible to attack. Finally, a large outbreak has not occurred on the Plateau in over 40 years, and, if past records of infestation frequencies are any indication, a severe outbreak could be expected to occur in the near future.

Barring factors that would reduce the insect population, the outbreak is expected to increase above 4.5 trees per acre in 1975. Removal of infested trees prior to the beetle flight in July could reduce the number of trees infested in 1975 in the sale area due to a reduction in susceptible host type. However, the course of the outbreak in other areas would not be changed to any significant extent. Tree losses are expected to increase to the east and south of the sale area.

ALTERNATIVES

The following management practices have been utilized in the past in ponderosa pine forests threatened by the mountain pine beetle:

1. Treat all infested trees. Individual treatments of infested trees by fall and burn or fall and chemically treat have been used in attempts to suppress past outbreaks. There is rather conclusive evidence that these methods failed to accomplish acceptable control, because stand conditions favoring the outbreak were not changed. The only advantage of these suppression methods is in delaying tree mortality and, thus, permitting more orderly harvest of killed or infested trees. To be effective, however, every infested tree has to be located and properly treated. Also, a commitment to treat currently infested trees for several years has to be made. Costs for this type of treatment are exceedingly high.
2. Control by logging. In practice, this technique of removing infested trees with other merchantable ponderosa pines would be less effective than falling and burning or spraying, because non-merchantable trees that were infested would not be logged. For logging to be effective, most vulnerable stands on the Plateau would have to be logged on an orderly basis. Logging to this extent is ordinarily not practicable, especially once an outbreak has begun.
3. Sanitation-salvage logging. This technique involves removal of currently infested trees, dead trees, and some live trees. Unless all infested trees are logged, no appreciable effect on the overall course of an outbreak could be achieved by this method. Once again, this technique involves individual tree removal.
4. Combination of techniques. All of the above mentioned techniques could be used in varying combinations in an attempt to suppress the outbreak. Such an approach is basically the same as the individual management technique given above, insofar as it consists of individual tree treatment. All of the drawbacks of each technique remain.
5. Do nothing. When the costs of suppression outweigh the benefits, or effective suppression techniques are not available, tree losses incurred during an outbreak have to be accepted as an inevitable event.

Theoretically, mountain pine beetle outbreaks could be prevented on the Kaibab Plateau through silvicultural practices, even though data are not available to completely support this supposition. To accomplish long-term prevention, all susceptible stands, with sawtimber-size trees, would have to be logged at an orderly and uniform rate and converted to younger size classes or to other tree species. The possibility of accomplishing this type of prevention would appear to be small because of administrative, wildlife, aesthetic, and many other considerations.

RECOMMENDATIONS

Suppression by individual tree treatment of any type is not recommended. As long as stand conditions remain favorable for mountain pine beetle on the Kaibab Plateau, suppression efforts will only slow the outbreak, not stop it. Tree losses inevitably would be about the same.

Immediate Action.--Sanitation-salvage logging is recommended where it is administratively feasible. It should be emphasized that this approach will not affect the overall course of the outbreak, but the timber resource will be utilized instead of lost. Salvage should be undertaken in areas where groups of ponderosa pines have been killed. Aerial survey maps showing the locations of 1975 "faders" will be provided to the Forest next summer to help locate possible salvage areas. As many as possible of the live ponderosa pines above 15 inches in diameter and all currently infested trees also should be removed.

Where intensive salvage logging is not feasible, resource losses will have to be accepted.

Long-Term Action.--To the extent possible, sawtimber-size stands should be converted to younger ponderosa pine or mixed conifer stands. Prevention of tree losses within logged areas can be achieved in part by this practice, but tree losses due to the mountain pine beetle in unmanaged ponderosa pine stands will not be prevented.

LITERATURE CITED

- Blackman, M. W. 1931. The Black Hills beetle (Dendroctonus ponderosae Hopk.). Bull. of the N.Y. State Coll. of Forestry at Syracuse Univ., Vol. IV, No. 4, Tech. Publ. No. 36. 97 p.

A P P E N D I X

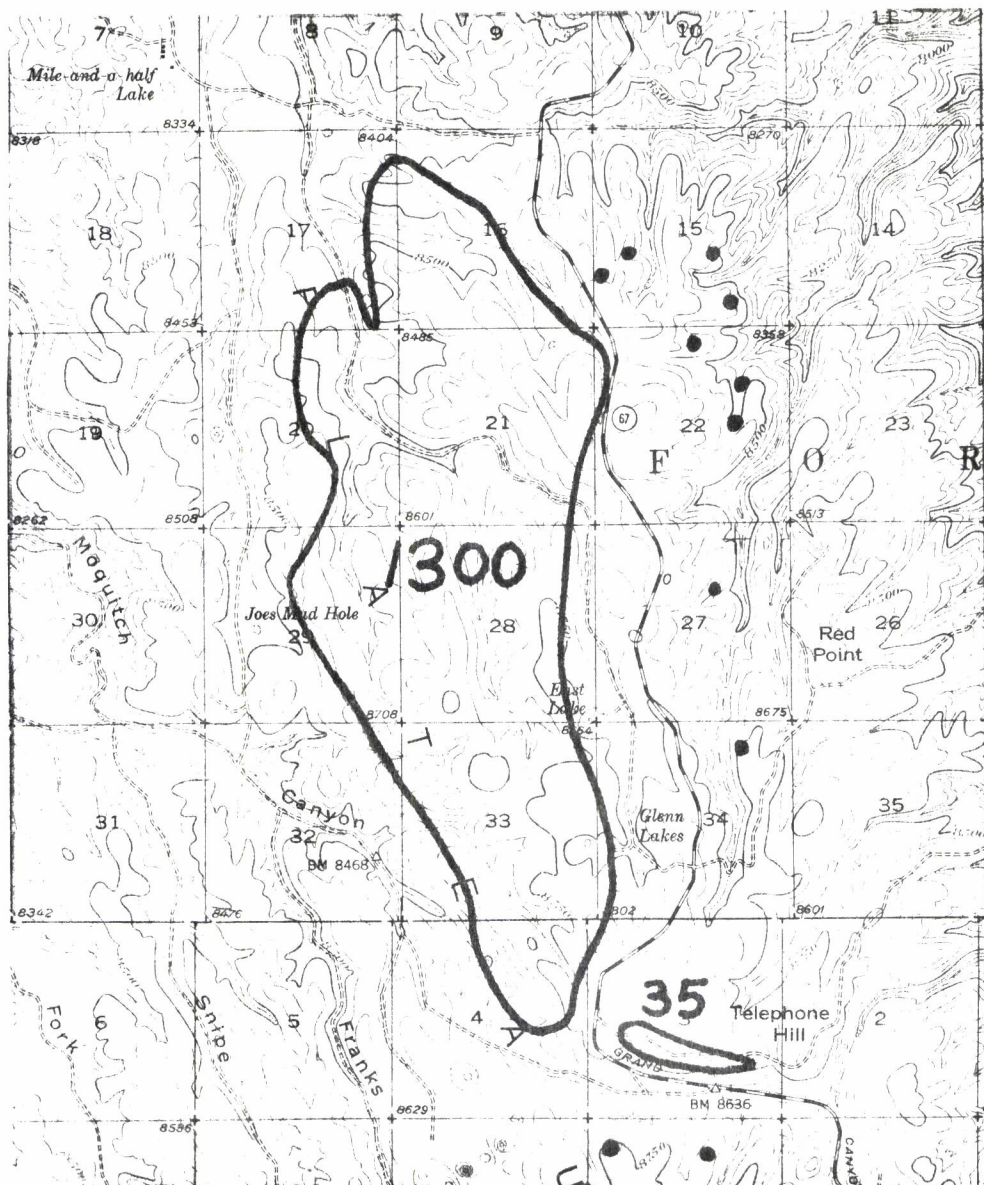


Fig. 1.--Extent of the mountain pine beetle outbreak on the Kaibab National Forest, 1974. Aerial estimates of currently faded trees are shown, and the spots indicate 1 to 10 dead trees.



Fig. 2.--Infrared (top) and color (bottom) aerial photographs show clumps of ponderosa pine killed by the mountain pine beetle, Kaibab National Forest, 1974. On the infrared photograph, purple-colored trees are living, and light green to white trees are dead.

Table 1.--Estimates of live trees per acre and basal area per acre in the East Lake timber sale area, Kaibab National Forest.

D.b.h. (in.)	Black- jack	Yellow pine	White fir	Douglas- fir	Blue spruce	Engelmann spruce	Aspen	Total	Total pine mortality	Total stand
4	9.06		10.42	3.17	1.81	0.45	19.03	43.94	0.03	43.97
5	10.73		10.44	2.32	2.32		13.92	39.73	0.23	39.96
6	6.24		6.63	1.41	2.01	0.20	13.67	30.16	0.37	30.53
7	4.14		3.70	2.66	0.74	0.15	13.76	25.15	0.36	25.51
8	2.83		4.86	1.58	1.02	0.11	11.41	21.81	0.20	22.01
9	1.88		3.29	1.42	0.80	0.18	7.74	15.31	0.60	15.91
10	2.54		2.88	0.50	0.58	0.07	4.61	11.18	0.30	11.48
11	1.56		2.10	0.66	0.72	0.18	3.54	8.76	0.59	9.35
12	1.81		1.20	0.85	0.95	0.05	2.95	7.81	0.16	7.97
13	1.24		1.25	0.56	0.43	0.09	1.85	5.42	0.56	5.98
14	1.26	0.04	1.33	0.33	0.37	0.07	1.15	4.55	0.43	4.98
15	1.03	0.03	0.83	0.48	0.35	0.03	0.67	3.42	0.39	3.81
16	1.22		0.90	0.22	0.22	0.03	0.42	3.01	0.66	3.67
17	1.30	0.03	0.83	0.20	0.20		0.45	3.01	0.49	3.50
18	0.85		0.55	0.15	0.20	0.02	0.24	2.01	0.49	2.50
19	1.08		0.66	0.26	0.18		0.14	2.32	0.50	2.82
20	0.98	0.09	0.59	0.13	0.23	0.02	0.11	2.15	0.43	2.58
21	1.13	0.03	0.40	0.11	0.03		0.06	1.76	0.43	2.19
22	0.99	0.06	0.21	0.05	0.09			1.40	0.23	1.63
23	0.81	0.04	0.17	0.14	0.10		0.01	1.27	0.53	1.80
24	0.83	0.12	0.30	0.08	0.05	0.01		1.39	0.22	1.61
25	0.59	0.12	0.22	0.04	0.02			0.99	0.23	1.22
26	0.59	0.11	0.20	0.04	0.03			0.97	0.17	1.14
27	0.36	0.09	0.17	0.05	0.02			0.69	0.23	0.92
28	0.44	0.07	0.16	0.02	0.04			0.73	0.16	0.89
29	0.21	0.06	0.16	0.04	0.01			0.48	0.17	0.65
30	0.16	0.06	0.03	0.03	0.01		0.01	0.30	0.09	0.39

Table 1.--Estimates of live trees per acre and basal area per acre in the East Lake timber sale area, Kaibab National Forest (cont'd.).

D.b.h. (in.)	Black- jack	Yellow pine	White fir	Douglas- fir	Blue spruce	Engelmann spruce	Aspen	Total	Total pine mortality	Total stand
31	0.10	0.13	0.08	0.03	0.02		0.01	0.37	0.03	0.40
32	0.08	0.10	0.06	0.01	0.01			0.26	0.03	0.29
33	0.07	0.07	0.08					0.22	0.13	0.35
34	0.06	0.06	0.02	0.01				0.15	0.03	0.18
35	0.04	0.07	0.02	0.02	0.01			0.16	0.10	0.26
36	0.02	0.02	0.02	0.03	0.01			0.10		0.10
37	0.01	0.04	0.02	0.02	0.01			0.10		0.10
38	0.01	0.04	0.01					0.06		0.06
39		0.03	0.02	0.01	0.01			0.07		0.07
40	0.01	0.02	0.01	0.01				0.05		0.05
41		0.01						0.01		0.01
42		0.01	0.01					0.02		0.02
43		0.01						0.01	0.03	0.04
Total	56.26	1.56	54.83	17.64	13.60	1.66	95.75	241.30	9.60	250.90
%	22	1	22	7	5	1	38	96	4	100
BA/A*	48.06	6.92	30.28	10.16	7.94	0.79	30.83	134.98	17.53	152.51
%	31	5	20	7	5	1	20	89	11	100

*Basal area (sq. ft.) per acre.

Table 2.--Estimates of mountain pine beetle-caused mortality of ponderosa pine in trees per acre and basal area per acre in the East Lake timber sale area, Kaibab National Forest.

D.b.h. (in.)	Trees/acre			
	New	Old	Snag	Total
4	.03			.03
5	.10		.13	.23
6	.20	.07	.10	.37
7	.13	.10	.13	.36
8		.07	.13	.20
9	.20	.10	.30	.60
10	.16	.07	.07	.30
11	.26	.20	.13	.59
12		.03	.13	.16
13	.26	.10	.20	.56
14	.10	.20	.13	.43
15	.16	.13	.10	.39
16	.33	.07	.26	.66
17	.30	.03	.16	.49
18	.36		.13	.49
19	.20	.20	.10	.50
20	.33		.10	.43
21	.23	.07	.13	.43
22	.10		.13	.23
23	.20	.26	.07	.53
24	.16	.03	.03	.22
25	.20		.03	.23
26	.10		.07	.17
27	.13		.10	.23
28		.03	.13	.16
29	.07		.10	.17
30	.03	.03	.03	.09
31		.03		.03
32	.03			.03
33	.03	.03	.07	.13
34		.03		.03
35	.03	.07		.10
43	.03			.03
Total	4.46	1.95	3.19	9.60
BA/A*	8.47	3.59	5.47	17.53

*Basal area (sq. ft.) per acre.

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